

REMARKS

Reconsideration and re-examination are hereby requested.

Before discussing the claims and how they distinguish over the cited art perhaps it might be helpful to review features of applicants invention.

Referring to FIG. 5, a portion of a semiconductor body 100, here a single crystal silicon body is shown having formed thereon an the alignment sites, five sites (i.e., site 1, site 2, site 3, site 4 and site 5) along the top outer peripheral portion of the wafer and five sites (i.e., site 1, site 2, site 3, site 4, and site 5) along the lower outer peripheral portion. Each one of the sites is identical, an exemplary one thereof being shown in detail in FIG. 6. It is noted that the alignment site includes a single, composite alignment mark 102. The alignment mark 102, as noted above, is formed in a portion of the surface 104 of the semiconductor body 102, here as grooves 106. The surface 104 of the semiconductor body 102 is adapted to reflect light energy impinging on such surface with a predetermined wavelength.

More particularly, the semiconductor body 100 has an alignment mark 102 comprising a pair of sets of parallel lines 112, 114 (FIG. 6) disposed on the semiconductor body 100, the parallel lines 112 in one of the sets being disposed orthogonal to the parallel lines 114 in the other one of the set, the two sets of parallel lines 112, 114 being in an overlaying relationship to provide a composite mark at each one of the sites (FIG. 5).

Apparatus 200 shown in FIG. 8 is provided for detecting the alignment mark 102 (FIG. 6) on a semiconductor body 110. As noted above, the alignment mark 100 comprises a pair of sets of parallel lines 112, 114 (FIG. 6) disposed on the semiconductor body 100. The parallel lines 112, 114 in one of the sets is disposed orthogonal to the parallel lines 112, 114 in the other one of the sets. The alignment mark 102 includes, as noted above, grooves 106 having sidewalls 108 terminating at the surface 104 of the semiconductor body 100, as indicated in FIG. 8. The grooves 106 have bottom portions 110 recessed into the surface portion of the semiconductor body 100. The two sets of parallel lines 112, 114 are in an overlaying relationship. The apparatus 200 includes an optical system 202 for scanning an alignment illumination 204 comprising a pair of orthogonal, laterally displaced, along the X axis, lines 208,

210 of impinging light over the surface of the alignment mark 102. One of the pair of impinging light lines, here line 208, is orthogonal to, and laterally displaced from, the other one of such pair of impinging light lines 210. Here, the line 210 is projected onto the surface of the wafer 100 at an angle of - 45 degrees with respect to the Y axis (FIG. 5) and the line 208 is projected onto the surface of the wafer 100 at an angle of + 45 degrees with respect to the Y axis (FIG. 5). The impinging light (i.e., the alignment illumination) is reflected by the surface of the semiconductor body 100 when such impinging light is over the composite alignment mark 102 to provide a corresponding pair of laterally displaced beams 211, 213 of reflected light. The apparatus includes a detector arrangement 220. The detector arrangement 220 includes a pair of detectors configurations 220₁ and 220₂. The projected beams 211, 213 are directed by the optical system 200 to the detector configurations 220₁ and 220₂, respectively, as indicated. The detector configuration 220₁ includes a pair of detectors 222₁ and 222₂, shown in FIG. 8. Shown diagrammatically with the detectors 222₁ and 222₂ is the projection of the illumination 210 (i.e., 210') if the surface of the wafer 100 were perfectly flat. Thus, detectors 222₁ and 222₂ are positioned to detect energy reflected by lines 112 (FIG. 6).

In like manner, the detector configuration 220₂ includes a pair of detectors 222₃ and 222₄, shown in FIG. 8. Shown diagrammatically with the detectors 222₃ and 222₄ is the projection of the illumination 208 (i.e., 208') if the surface of the wafer 100 were perfectly flat. Thus, detectors 222₃ and 222₄ are positioned to detect energy reflected by lines 114 (FIG. 6).

With such apparatus, the alignment illumination is scanned over the surface of the alignment mark 102, one of such pair of impinging light lines 108 being orthogonal to, and laterally displaced from, the other one of such pair of impinging light lines 110, impinging light being reflected by the alignment lines in the surface of the semiconductor when such impinging light is over to provide a pair of laterally displaced beams 211, 213 lines of reflected light. The detectors 222₁, 222₂, 222₃ and 222₄ detect in each one of a pair of laterally spaced detector configurations 220₁, 220₂, respectively, a corresponding one of the laterally displaced beams 211, 213 of reflected light. The - 45 degree and + 45 degree oriented alignment lines 208, 210, respectively, of the cross-shaped alignment illumination 204 are separated locally by at least the width W (FIGS. 6 and 8) of the alignment mark 102. This will result in the alignment mark

being scanned first by the + 45 degree line 208 and subsequently by the - 45 degree line 210. This arrangement allows the separation of the alignment detectors 222₁, 222₂ and 222₃, 222₄ for + 45 degree and - 45 degree orientations, respectively. As a result, each signal, or waveform, produced by the detectors can be recorded without background noise from the other line orientation.

Referring now to the claim, claim 4 points out that:

1. The alignment mark comprising a pair of sets of parallel lines disposed on the semiconductor body, the parallel lines in one of the sets being disposed orthogonal to the parallel lines in the other one of the set, the two sets of parallel lines being in an **overlying relationship**; and
2. The optical system scans an alignment illumination comprising a pair of orthogonal, lines of impinging light over the surface of the alignment mark, ***one of such pair of impinging light lines being orthogonal to, and laterally displaced from, the other one of such pair of impinging light lines***, impinging light being reflected by the alignment lines in the surface of the semiconductor when such impinging light is over to provide a pair of laterally displaced beams of reflected light.

Referring now to Nishi it is first noted that the pair of alignment lines 24X and 254Y in FIG. 2b are not in overlying relationship. It is next noted that the one of the pair of **IMPINGING LIGHT LINES** (as distinguished from a **reflected** light line) is not laterally displaced from the **IMPINGING LIGHT LINES** of the other one of the pair of **impinging** light lines.

It is respectfully submitted therefore that claim 4 is patentable over Nishi (US Patent No. 6,411,386).

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